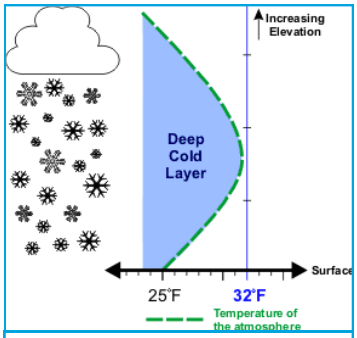
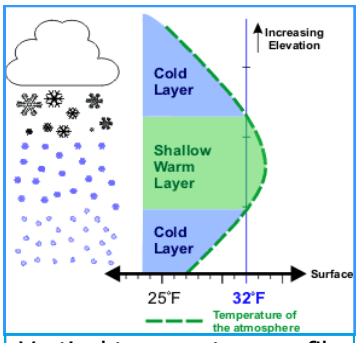
Determining Winter Precipitation Types

One of the difficult tasks for a forecaster is trying to figure out what type of precipitation is going to occur in the winter. An important piece of the puzzle involves determining the temperature throughout the troposphere (basically the lower 7-8 miles of the atmosphere) where the temperature usually decreases with height. However there are times when the temperature actually increases with height in the lower troposphere and this can cause problems for the forecaster.



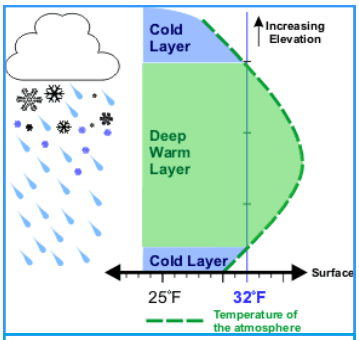
Vertical temperature profile needed for snow

Snow/Rain Process: How does the temperature affect the precipitation type? Ice crystals form at heights where the temperature is several degrees below freezing. As they fall, the crystals grow by several times, eventually forming snowflakes. If the entire column of the atmosphere remains below freezing all the way to the ground, we get **snow**. However, what happens if the snowflakes encounter a warm layer in the atmosphere that is above freezing? If the layer is warm and/or deep enough, the snowflakes melt and we get **rain**.



Vertical temperature profile needed for sleet

Sleet Process: If the warm layer is not quite as warm or as deep (let's say a degree or two above freezing for 500 feet) the snowflakes will partially melt, and then refreeze as they encounter a cold layer closer to the ground. By the time they hit the ground they look like tiny frozen ice balls known as sleet.



Vertical temperature profile needed for freezing rain

Freezing Rain Process: This process is similar to sleet formation except that the warm layer completely melts the snowflakes into raindrops. But before reaching the ground, the rain falls through another cold layer. If the temperature in this layer and at the ground is several degrees below freezing, the rain drops will instantaneously freeze wherever they land (on trees, sidewalks, roads, power lines, etc.), causing a potential hazardous situation known as freezing rain.

Forecasters use information from radiosondes (weather balloons) to determine the temperature profile of the atmosphere. Due to cost factors, radiosondes are normally only launched twice per day at NWS sites across the country. In Nebraska, they are launched from the North Platte and Omaha offices. Due to the sparse coverage in both space and time, one can see where it might be tough to determine whether we will get snow in Chadron, while those in York may see a mixture of sleet, rain, and freezing rain.

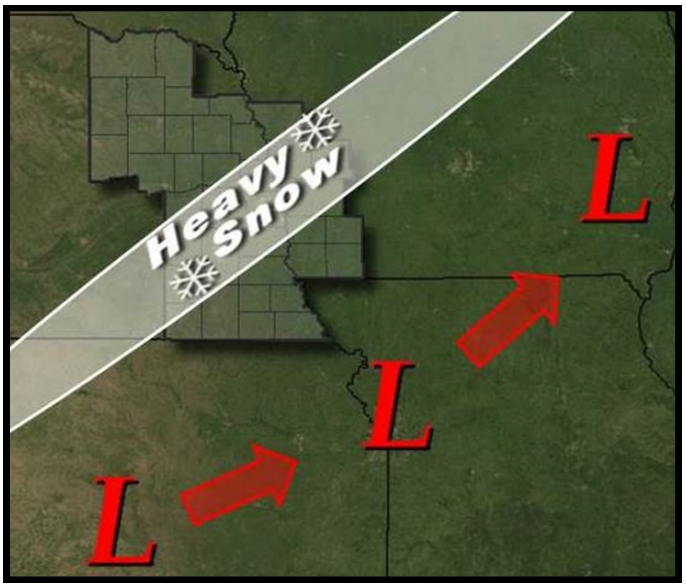
Challenges Of Forecasting Snowfall Amounts

Forecasting the amount of snowfall is challenging for meteorologists. Most people do not understand why forecasts for heavy amounts of snow can become a bust, or when little is expected you get dumped on. There are several factors involved in forecasting snow amounts. Let's take a look at some of them.

Surface Temperature - A ground temperature above freezing can cause much of the snow to melt upon impact. However, if it is snowing very hard, the snow could still accumulate and may get deep in some cases.

Precipitation Type - The temperature and moisture profiles in the lowest 10,000 feet of the atmosphere are critical in determining what type of precipitation you will have. The temperature at the surface does not necessarily indicate what sort of precipitation one will have. Refer back to page 15 for more detailed information about determining various precipitation types.

Storm Track - Another important consideration in forecasting snow amounts where the storm (Low Pressure) track is. The heaviest snow band typically occurs northwest of the surface low pressure track (see image to right). A shift north or south of the low can result in a shift of this band as well. Forecasters use their best judgement based on guidance from various computer models to determine the location of the heaviest band of snow.



Snow to Liquid Ratio - Many people use the rule of thumb that 1" of liquid water equals 10" of snow. This is not always the case, especially in the Plains states. Snow in this area is more typically 14 to 1 (or 14" of snow for every 1" of liquid water), but can vary quite a bit depending on the moisture content of the atmosphere. Very wet snows may have less than a 10 to 1 ratio and dry snows can have a 20 to 1 ratio! This can be an important factor in determining snowfall amounts.

Thunder Snow - There are times when a low pressure system moves across the area will have enough moisture and instability aloft to create thunder snow. In these cases, snowfall rates can increase tremendously and pile up 2 to 3" of snow per hour.

All of these factors are taken into consideration when forecasting snow amounts. Any changes to the factors listed, as well as some others not mentioned, can lead to a change in the amount of snowfall that was originally forecasted. It is important for everyone to pay close attention to updates to the forecast during a winter storm event to see if there are changes.